National Undersea Research Program

Scientific Guidance

FY 2003 Funding

March 5, 2002

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National Undersea Research Program (NURP)

FY 2003 SCIENCE GUIDANCE

Introduction

This document outlines NURP s science guidance to the NURP Centers for FY 2003.

The National Undersea Research Program (NURP) is a comprehensive underwater research program that places scientists underwater, directly through the use of submersibles, underwater laboratories, and advanced wet diving, or indirectly by using remotely operated vehicles (ROVs), autonomous underwater vehicles (AUVs), and observatories. This *in situ* approach allows acquisition of otherwise unobtainable observations, samples, and experimentation related to NOAA s and the Nation s priority research objectives. NURP provides access for the United States research community to civilian, military, and international undersea technology.

NURP is primarily a grant program with most of its funding going to the extramural (outside NOAA) research community, primarily academia. NURP-supported research quality is ensured by competitive and high standards of peer review. Highest priority is given to proposals for studies in the large lakes, territorial seas, and adjacent waters of the United States. Responsibility for soliciting and supporting the research is assigned to regional Centers: North Atlantic and Great Lakes; Mid-Atlantic; Southeastern U.S. and Gulf of Mexico; Caribbean; West Coast and Polar; and Hawaii and Western Pacific (Fig. 1). The key NURP contacts, addresses, and phone numbers are provided in Table 1.

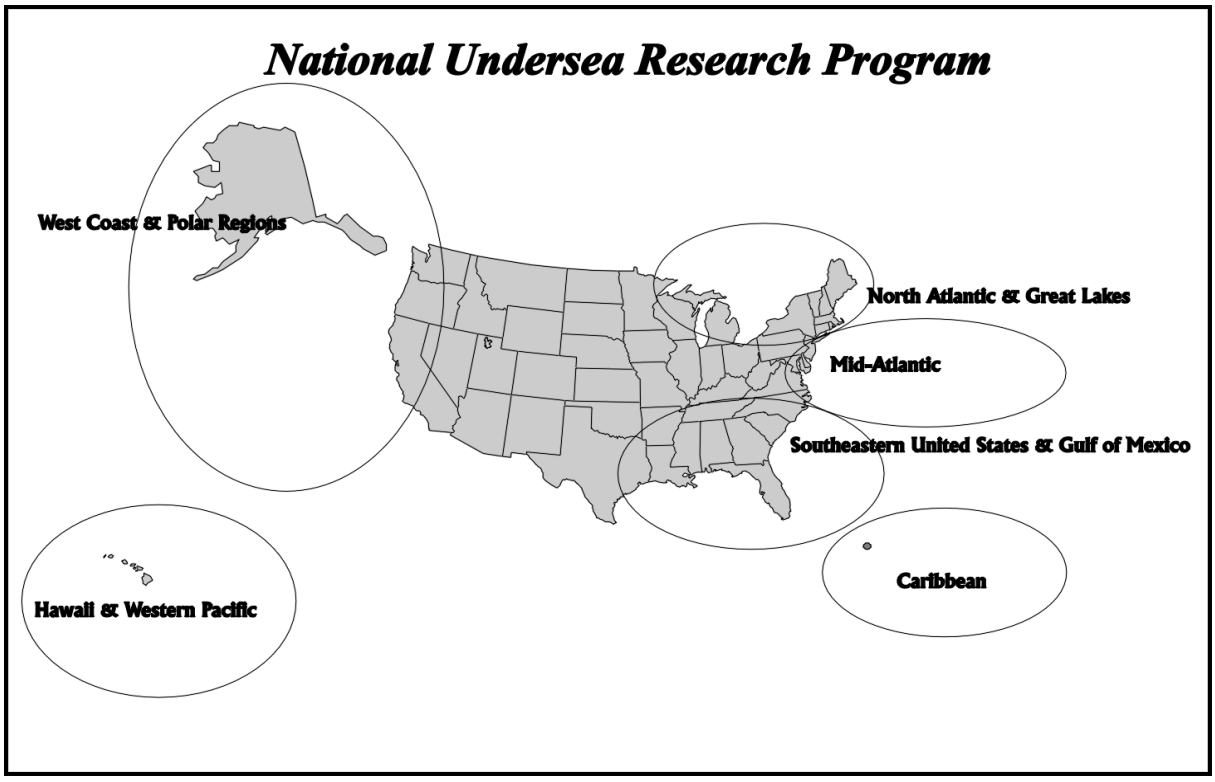

Fig. 1. LOCATIONS AND REGIONS OF CENTERS

Table 1. NATIONAL UNDERSEA RESEARCH PROGRAM CONTACTS

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Strategic Goals

NOAA s mission it to describe and predict changes in the Earth s environment and to conserve and manage the Nation s coastal and marine resources to ensure sustainable economic opportunities. For the year 2005, NOAA envisions a world in which societal and economic decisions are coupled strongly with a comprehensive understanding of the environment. The strategy consists of seven inter-related goals grouped within the primary themes of environmental stewardship and environmental assessment and prediction.

Environmental Stewardship	*Environmental Assessment and Prediction*
Build Sustainable Fisheries (BSF) ***Recover Protected Species (RPS)*** ***Sustain Healthy Coasts (SHC)***	***Advance Short-Term Warning and Forecast Services (STW)*** ***Implement Seasonal-to-Interannual Climate Forecasts (SI)*** ***Predict and Assess Decadal-to-Centennial Change (DC)*** ***Promote Safe Navigation (PSN)***

NURP s activities cut across the NOAA mission and goals. Its unique role and contributions to meeting NOAA s and national needs are primarily based on its undersea *in situ* science and technology expertise. One of its greatest strengths is reliance on partnerships with extramural programs to leverage and accomplish its mission:

NURP s mission is to increase knowledge essential for the wise use of oceanic, coastal, and large lake resources through advanced undersea exploration, sampling, observation, experimentation and education.

Science Guidance

NURP is one of the research arms of NOAA s Office of Oceanic and Atmospheric Research, or NOAA Research. Consequently, the NURP science guidance for FY 2003 is based on four of NOAA Research s strategies taken from A Strategic Plan for NOAA Research.

- *Build coastal and ocean prediction, exploration, and management tools.*
- *Increase collaborations with customers and partners in research.*
- *Build infrastructure capacity.*
- *Engage the public in science learning and problem-solving.*

This guidance will continue to include providing scientific support to other parts of NOAA in

fulfilling their missions, especially the National Marine Fisheries Service (NMFS) and the National Ocean Service (NOS). Such assistance includes conducting research needed for improved fisheries assessment, habitat mapping, habitat-species characterization, determinations of biodiversity, and determinations of habitat destruction, for example, through disruption of the sea bottom by fishing gear. It also includes studies on coral reefs, coastal water quality and threats thereto, beach and other habitat erosion, other natural and anthropogenic hazards; and marine sanctuaries and marine protected areas. There is also the need to better understand the relationships between the oceans, including the deep ocean, and climate change, and to discover resources other than fisheries.

NURP believes that meeting these challenges depends on sound science, new discoveries, and active exploration of the seas. In part due to technology advancements in deep sea sampling and resource development, we know that there are far more non-living resources lying beneath the sea than ever before imagined. For example, seafloor and sub-seafloor gas hydrates (clathrates) abound deep off our coasts while these may contain enough fuel to sustain the nation for hundreds of years. They also support chemosynthetic ecosystems populated by largely undescribed extremophiles. NURP will need improved technologies to maximize the benefits and efficiency of its future endeavors. Activities will include exploring for and discovering new forms of life, for example those that exist in extreme environments such as deep sea vents and oil seeps; and understanding the ocean s ecosystems leading to using new resources, such as pharmaceuticals, in a truly sustainable way for generations to come.

To pursue the above strategies, particularly that of *Building Infrastructure Capacity*, NURP must enhance underwater technologies to meet the challenges that are posed. Through ownership or leasing, we already have a large infrastructure capability that includes submersibles, ROVs, AUVs, advanced diving capabilities, underwater habitat and seafloor observatories. We need to start asking ourselves whether this is the right mix for the future and, if not, what else is needed or not needed. And, in these times of budget uncertainties, how do we go about obtaining the right mix, a mix that can evolve and stay current with the times and problems posed? Certainly our expertise in forming creative partnerships is going to play a big role. Successfully addressing the fourth strategy, *Engage the public in science learning and problem-solving* is going to be crucial to our success.

The four NOAA Research strategies noted above lead to the following goals and objectives in which NURP will play a role.

1. Promote healthy coasts and effective management. The nation's coastal margins, home to over half of the population, are the most densely populated areas in the United States. Much of the national economy is dependent upon a healthy and vibrant coastal zone recreational and commercial fishing, seafood processing, coastal-based recreation and tourism, the boating industry, ports and harbors, marine shipping, offshore oil and gas, marine equipment manufacturing. Aesthetic, cultural, and environmental aspects of the coastal margin significantly enhance its value. Clearly, economic growth and environmental protection are inextricably

linked.

Driven by concern for the health and conservation of marine ecosystems and resources, certain marine and coastal areas are of particular concern (e.g., coral reefs). For example, the National Marine Sanctuaries (NMS) and National Estuarine Research Reserve System (NERRS) need to identify, designate, and manage areas of the marine environment of special national significance due to their conservation, recreational, ecological, historical, research, educational, or aesthetic qualities. Although these areas are not the only areas with such needs, they do offer sites where research would be particularly relevant to NOAA s and NURP s mission. They also offer the potential of developing partnerships with NOAA s National Ocean Service. Information gained through such programs is needed for site management, education, research planning, incident response, and damage assessments.

1.1 Perform research, monitoring and comprehensive site characterizations (including assessment of patterns of biodiversity and the processes that maintain them) for key coastal habitats such as coral reefs and other critical habitat in NMS and NERRS sites, to allow for more efficient management of protected resources.

1.2 Support sound decision-making for the management of toxic contaminants by providing reliable scientific analysis of trends, transport, fate, and effects, for both point and non-point sources, and communicating these findings to policy makers.

1.3 Understand the effects of anthropogenic stressors on processes that affect specific life stages of marine organisms, particularly processes critical to population maintenance, such as reproduction (fertilization, metamorphosis, settlement, and recruitment). It is particularly important to understand what levels of exposure to stressors in the marine environment are acceptable, what limits ought to be targeted in monitoring programs, and what techniques are most appropriate to assess environmental exposure.

1.4 Investigate the causes and consequences of eutrophication in coastal and estuarine waters and work with policy makers to identify cost-effective alternatives for their control.

1.5 Seek better understanding of the role that lake and ocean habitats such as fish nurseries play in maintaining the health of living marine and Great Lakes resources.

1.6 Use tools from engineering, biotechnology, ecology, and genetics, to help identify aquatic nuisance species, their life cycle and ecological relationships.

1.7 Assess the physical and biological impacts of natural and anthropogenic-related disasters (e.g., hurricanes, tsunami, flood plumes, pollutant spills), and develop methods to evaluate the economic costs of destruction and recovery.

The National Marine Fisheries Service also has interest in many of these areas because of

responsibilities related to building sustainable fisheries and recovering protected species through, for example, a better understanding of essential fish habitat.

2. Foster ocean stewardship. Nearly a third of our nation s fisheries are over-fished and stocks are collapsing. Additionally, habitat is degrading and rebuilding protected species is an ever-increasing challenge. The reasons are varied and complicated; some are natural and cyclical (e.g., change in a climate regime), while others are caused by humans (e.g., over-fishing). Fish are selective about where they live. With the advent of new fishing technologies, for example, inexpensive satellite positioning, commercial and recreational fishermen have gotten better at finding and targeting the fish habitats. Destructive fishing practices degrade these habitats, e.g., anchored gill nets are destroying fragile coral reefs. Trawls customized for rock-hopping plow through rocky substrate, topple boulders, and bury the encrusting species that attract fish. Many fisheries are pushed to deeper depths as shallow resources are depleted, and therefore we know even less about their ecology and habitat.

2.1 Improve stock assessments of mammals, fishes, and invertebrates by developing and employing advanced technology, providing comparative data on populations, and improving and developing population and community models.

2.2 Identify and map Essential Fish Habitat (EFH, as defined in the Magnuson-Stevens Act), determine habitat requirements for healthy populations, assess damage from mobile fishing gear, and provide research results that increase managers ability to identify, protect, and restore EFH.

2.3 Conduct research on the life histories of marine animals of commercial or ecological importance, including reproduction, feeding, behavior, age and growth, and distribution.

2.4 Conduct studies to determine the effectiveness of Marine Protected Areas (MPAs) and marine zoning for conserving fish stocks, essential fish habitat (including conservation of biological diversity), and for contributing new productivity to adjacent unprotected areas.

2.5 Improve the ability to accurately predict the effects of changes in physical parameters by determining the relationships of oceanographic and climatic conditions to the abundances of living marine resource populations and communities.

2.6 Identify and quantify damage to fisheries resources and their habitat resulting from, e.g., fishing gear impacts and contaminant input and spills, and determine rates of impact recovery.

2.7 Provide scientific knowledge to assist NOAA Fisheries in developing the requirements for the siting of aquaculture operations in the EEZ.

2.8 Conduct studies of habitat preference, including ontogenic shifts, for target species in

order to optimize stock enhancement efforts.

2.9 Determine the effectiveness of stock enhancement efforts, including replenishment of wild populations with hatchery reared juveniles.

2.10 Assess the effectiveness of habitat enhancements designed to improve the success of stock enhancement efforts.

This objectives would be accomplished in cooperation with the National Marine Fisheries Service to provide the research results to improve federal and state abilities to effectively manage and restore fisheries. The National Ocean Service also has interest in some of these areas (e.g., MPAs) because of responsibilities related to sustaining healthy coasts through such programs such as the National Marine Sanctuaries and the National Estuarine Research Reserve System.

3. Explore our oceans and Great Lakes. While the oceans cover most of the Earth, 95% of the ocean and seafloor are unexplored. With imagination and a pioneering spirit, significant new opportunities will present themselves in the exploration of this inner space. Scientists have already shown that the deep sea is far from a barren desert and is inhabited by some of the most diverse, productive ecosystems on the planet. A wealth of untapped living and non-living resources lie hidden at this frontier. For example, the right combination of pressure and temperature results in beds of gas hydrates that may contain enough fuel to sustain the nation for hundreds of years. In fact, the ocean floor constantly vents and seeps a wide array of chemicals and materials, at rates and amounts capable of affecting ocean chemistry on a regional scale. In turn, changing chemistry impacts how the oceans absorb (or release) greenhouse gases, process contaminants, give rise to new pharmaceuticals, and sustain life.

3.1 Develop new technologies that promote *in situ*, long-term research, including autonomous underwater vehicles, underwater observatories, and chemical, physical, and biological sensors that are needed to study critical elements and forcing factors in the marine environment.

3.2 Expand the monitoring of vents, seeps, and volcanism and the flux of materials emanating from them, and biological communities associated with them.

3.3 Seek out, recover, isolate, and culture novel organisms from unique, extreme environments such as deep sea vent systems.

3.4 Identify unique bioactive compounds with commercial potential associated with marine organisms.

3.5 Characterize deep sea communities and the processes that regulate patterns of biological diversity to better understand any human caused effects of exploitation (now and in the future).

3.6 Conduct basic and applied research to identify, explore, assess, and develop gas hydrates as a source of energy.

3.7 Assist in developing technologies required for efficient and environmentally sound development of gas hydrate resources.

3.8 Conduct basic and applied research to assess and mitigate the environmental impacts of hydrate degassing (including both natural degassing and degassing associated with commercial development).

4. Develop the appropriate technologies. The changing and difficult study of the ocean realm requires new intellectual approaches and a national investment in a new mode of conducting marine investigations. Surface-ship expeditions have dominated ocean science since World War II. New approaches, such as seafloor observatories greatly enhance traditional capabilities by providing invaluable long term monitoring and continuity of observations. They are an example of the next generation in the development of technology for understanding the oceans. Recent technological advancements in low-power miniaturized components enable development of ocean floor stations that feature a wide variety of *in situ* sampling tools and sensors. Mini-robots, or autonomous underwater vehicles (AUVs), use them as home base to power-up and down-load acquired data, thereby extending the geographic range of the station. Real-time data and imagery are routinely transmitted to land-based laboratories and the Internet via cables, radio, or satellite connections. Through them, scientists can control *in situ* experiments and equipment from their laboratories.

Experiments and sample collections carried out at permanent seafloor installations and observatories provide information needed to understand and sea floor ocean processes, fish and ecosystem interactions, and predict the impacts of natural and human-induced changes. Through continued presence, scientists gain access to remote, rarely seen environments and events. Researchers can observe and describe complex chemical, physical, and biological processes that cannot be understood using only occasional, snapshot measurements. The general public benefits in the long term because a better understanding of the oceans and their resources will enable more informed policy choices as ocean development progresses. Students learn by interacting in the exciting world of undersea science.

4.1 Develop new technologies that promote *in situ*, long-term research, including autonomous underwater vehicles, underwater observatories, and chemical, physical, and biological sensors that are needed to study critical elements and forcing factors in the marine environment.

4.2 Expand the monitoring of vents, seeps, and volcanism and the flux of materials emanating from them, their effect on the ocean and atmosphere, and associated biological communities associated with them.

5. Excite the nation about the oceans. Education and outreach must be linked to NURP s research program and innovative means must be developed to bring the excitement of discovery to the living room and classroom. Future support for ocean research and its next generation of research scientists are but a few of the opportunities to be gained from a strong education and outreach program. As a start toward meeting this goal, NURP must pursue the following objectives.

5.1 Contribute to educational outreach programs, e.g. in conjunction with the National Sea Grant Program, to enhance awareness and understanding of ocean processes, ecosystems and resources, and their study, management, and conservation.

5.2 Hold periodic regional workshops regarding NURP research directions, necessary actions, NURP priorities, and the development of initiatives to provide a forum for all participants to listen, inform themselves, discuss, explain, and exchange views.

5.3 Promote formal and informal partnership agreements both inside and outside of NOAA.

5.4 Establish easily accessible communications links through Web pages, electronic bulletin boards, and printed material to provide current information to all our partners and customers regarding current research, future plans, and policy developments. This will require assessing the level of knowledge currently available from NURP sponsored research and the need for additional information.

5.5 Encourage publication of articles in the popular press, including scientific outlets for laypersons, newsletters, newspapers, and publications of trade and hobby organizations with interests affected by NURP management and research.

Concluding Remarks

The above five objectives constitute the NURP FY 2003 Science Guidance. It is based on the NURP Strategic Plan. These objectives are meant to guide the NURP Centers in forming their approaches to planning their science programs for FY 2003. The Centers will continue to consider their individual capabilities, expertise, and unique regional priorities in developing their approaches.